5 Parks for Science

"The parks are invaluable for unraveling the mysteries of natural and human history, evolutionary adaptation, ecosystem dynamics, and other natural processes."

—National Research Council

As home to relatively intact natural systems and significant cultural treasures, the National Park System offers enormously important opportunities for investigating scientific questions. The designation of 38 national park units as biosphere reserves and world heritage sites largely reflects the international scientific significance of these resources. As stewards of many of the world's premier natural and historical sites, the National Park Service is working to encourage parks-for-science research because the potential contribution to society is tremendous. The articles that follow highlight some of the fascinating discoveries, interesting research findings, and other research-related events in 2004, focusing on the myriad ways national parks contribute to scientific understanding of our world. Articles include a discussion of the activities of research learning centers to facilitate research, the use of elk and deer brain tissues from Rocky Mountain National Park to advance insights into chronic wasting disease, and recent discoveries of fossils and species new to science in national parks. From these articles we can see that the value of national parks as scientific laboratories will continue to grow in the face of accelerating local, regional, and global causes of environmental change and declining biological diversity, for the national parks contain precious information-gathering potentials that are not available anywhere else.

Long-term data show declines in insect composition on Plummers Island, Chesapeake and Ohio Canal National Historical Park

By John Brown

FOR MORE THAN 100 YEARS, insects have been collected on Plummers Island, a 49-acre (20-ha) site on the Potomac River and part of the Chesapeake and Ohio Canal National Historical Park. Before the island became a part of the National Park System, it was owned by the Washington Biologists' Field Club (a group of local naturalists and scientists) from about 1901 to 1958. The field club members conducted countless biological investigations on the island, resulting in significant collections of natural history specimens of plants and animals, which now reside in the National Museum of Natural History (USNM).

Because of the field club's active collecting and studies, Plummers Island is one of the few national park sites for which a prolonged survey of any biotic component has occurred. Data from these specimens provide the opportunity to examine changes over the past 100 years, showing the value of intensive local studies in the national parks. Insects are major contributors to ecosystem stability and serve a vital role in community structure. Understanding changes in the composition of the insect fauna may allow the National Park Service to better manage for biodiversity when undertaking habitat management, restoration, and pest management.

In 2004 the Natural Resource Preservation Program–Biological Resource Management Division funded a compilation and analysis of the insect data from Plummers Island. Researchers supervised the bar coding of more than 25,000 specimens and the data entry into a database maintained at the museum. Three USNM staff members were instrumental in facilitating the study: Dr. John Brown, for butterflies and moths (Lepidoptera); Dr. Thomas Henry, for true bugs (Heteroptera); and Dr. David Furth, for beetles (Coleoptera). These scientists documented a remarkable 2,761 insect species in 194 families, encompassing 10 insect orders (Odonata, Psocoptera, Dermaptera, Heteroptera, Neuroptera, Coleoptera, Diptera, Trichoptera, Lepidoptera, and Hymenoptera). Leading the pack are butterflies and moths, with a whopping 686 species; beetles are second, with about 600 species.

Preliminary analyses of the data indicate considerable turnover, or change, in the species composition in most families of insects since 1900. These findings may shed light on the types of changes that may be expected in the insect fauna in response to different land management strategies. One hundred years of development and urbanization of the area adjacent to and surrounding Plummers Island have resulted in considerable fragmentation of formerly large, contiguous tracts of habitat. Because past management of the site has been passive, primarily in the form of "protection" (i.e., limited active management), the vegetation has undergone natural succession from old field–open juniper (*Juniperus virginiana*) grassland with a heterogeneous (or diverse) patchwork of communities to a somewhat uniform subclimax oak-maple-hickory forest. The result is that many species of insects that prefer or even require open or successional habitats have disappeared. As many as 20% of the leaf-roller moths (Tortricidae) and 30% of the inchworm moths (Geometridae) present at the turn of the last century have disappeared. Likewise, colonization of the site by invasive weeds likely has replaced some native plants that formerly may have served as host plants for the larvae or caterpillars of phytophagous or plant-feeding insects.

The Washington Biologists' Field Club used the cabin atop Plummers Island, now a part of Chesapeake and Ohio Canal National Historical Park, as a research station in the early 20th century. Club members collected insects like the two adult limacodid moths (opposite page) and the common leaf-roller moths—*Endothenia hebesana*, above, and *Choristoneura rosaceana,* below. Afforded more than 100 years of insect collection data, in 2004 scientists analyzed changes in insect composition at the site.

Active management strategies that maintain a varied landscape, accompanied by the suppression of invasive weeds, may result in protected lands that support the highest species richness. The maintenance of some early successional habitat with accompanying "edges" may be critical for the maintenance of high species richness for many insect taxa, such as moths whose caterpillars specialize on herbaceous annuals, pollinators such as bees, and some predaceous beetles. Conflicts may arise between competing management alternatives. For instance, is it better to allow protected lands to revert to their former state through "natural" processes or to actively maintain small patches of open habitat for specific taxa or groups of species? As parks define the desired future conditions of sites, such questions must be answered and goals established. This scientific data summary gives management insight about the path their decisions will take regarding biodiversity on Plummers Island. ■

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Tomales Bay biodiversity inventory at Point Reyes and Golden Gate

By Ben Becker

THOUGH TOMALES BAY is still one of the most pristine, beautiful, and biologically diverse estuaries on the coast of California, past and present human uses of the bay and its watershed have had significant cumulative impacts on water quality, habitats, and species, resulting in a need for comprehensive watershed management. To accomplish this task, local, state, and federal stakeholders formed the Tomales Bay Watershed Council (www.tomalesbaywatershed.org) in 2000 to promote coordinated watershed-based resource management. The narrow, 12-mile- (19-km-) long bay is a combination of National Park Service, National Oceanic and Atmospheric Administration, and California state waters, with overlapping jurisdictions and significant water inflow from private and public lands throughout the watershed. Thus, collaborative stakeholder decision making by the watershed council is essential to addressing regional impacts on the bay from throughout the watershed.

Past and present human uses of the bay and its watershed have had significant cumulative impacts.

Following the lead of Great Smoky Mountains National Park, the Pacific Coast Science and Learning Center at Point Reyes National Seashore began an All Taxa Biodiversity Inventory of Tomales Bay in 2002. The Science and Learning Center primarily facilitates the marine and coastal research and educational programs for Point Reyes National Seashore and Golden Gate National Recreation Area, but also provides educational support to other national parks in the San Francisco Bay area. The purpose of this collaborative inventory is to catalog all forms of life in the bay, which will inform conservation and management decisions initiated by the watershed council, the National Park Service, and other stakeholders. The Pacific Coast Science and Learning Center coordinates research, secures funding, and serves as a data repository and disseminator, thereby providing sound environmental data for local conservation groups and government agencies. Without a scientific program or funding for researchers or database management, the Tomales Bay Watershed Council is the center's primary customer for data. Hence, the Pacific Coast Science and Learning Center has adopted the role of scientific aid for the council, and results from the biodiversity inventory will be critical for making sound conservation and restoration decisions.

The Science and Learning Center's biodiversity inventory program is currently coordinating and funding many projects. For example, native oyster restoration will create habitat and improve water quality on the bay. Mapping and experimental removal of invasive green crab and other invasive species, including *Didemnum lahillei* (a clonal tunicate that fouls native communities; see sidebar on page 43), will help in developing effective control plans. In addition, staff is compiling all existing biodiversity and habitat data into a single database. This information is now available at www.tomalesbaylife.org for those who need references to keying out newly found species. The center is developing online field guides, a comprehensive online bibliography of all scientific literature concerning the bay, and a water quality monitoring database. Also, each year the Science and Learning Center sponsors 10 graduate-level research projects that pertain to understanding, mapping, and protecting the biodiversity of the bay. Fundraising for future water quality monitoring and pollution source detection is ongoing. To complete all these projects, staff works extensively with faculty and students from local universities and with foundations interested in funding projects that will help

Macrocystus kelp beds occur in several small pockets in Tomales Bay, enriched by the strong tidal action that brings abundant nutrients in contact with the rapidly growing kelp.

This scanning electron microscope image shows the head of the Tomales sea flea, a newly discovered crustacean in the family Leptostraca, genus *Nebalia*, that has not yet been assigned a species name.

preserve watersheds and marine systems in the context of community involvement.

The biodiversity inventory in Tomales Bay has already uncovered several new management concerns: discovery of invasive tunicate *Didemnum lahillei* in the bay and discovery of a crustacean new to science in the family Leptostraca, genus *Nebalia*. The new crustacean lives in the eelgrass beds of Tomales Bay; its bright green color blends with the deep green eelgrass. A collaborator in the biodiversity inventory, Leslie Harris of the Natural History Museum of Los Angeles County, who oversees much of the invertebrate inventory work, first collected the species. Currently, a graduate student at UCLA, Todd Haney, is describing and naming the crustacean. Investigators also have found a new sea anemone never before seen on the West Coast, but believed to be a species common on the East Coast. Genetic tests will soon reveal if this is another invader or if it is a new species.

While interacting with both park and local stakeholders, the Pacific Coast Science and Learning Center meets scientific and data management needs. Its adaptable core facility and specialized staff can provide research assistance, information management, and fundraising for rapidly changing resource management needs. ■

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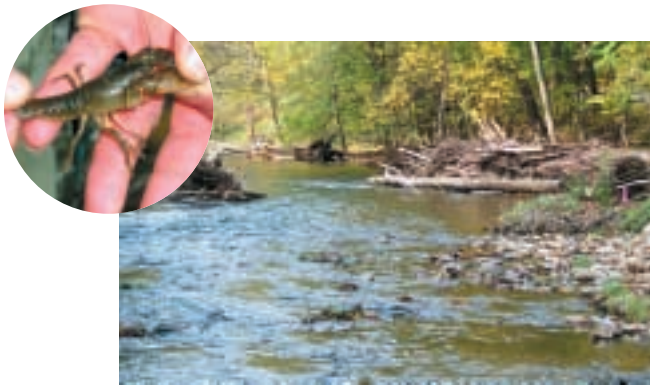
Crayfish previously unknown in Pennsylvania found at Valley Forge

By David A. Lieb and Betsie Blumberg

A species of crayfish is thriving in Valley Creek at Valley Forge National Historical Park, although scientists have never before seen it in Pennsylvania. Researchers from Penn State University, David Lieb and Dr. Robert Carline, surveyed the portion of the creek that flows through the park and identified the crayfish as part of the *Cambarus acuminatus* complex, a group of related species, most of which have not yet been described and named. The survey, undertaken with NPS regional funding, has resulted in a commitment of the two monitoring networks in Pennsylvania (Mid-Atlantic and Eastern Rivers and Mountains) to do crayfish surveys in all Pennsylvania park units. No member of the subgenus *Pucticambarus,* which includes *C. acuminatus*, has previously been reported in eastern Pennsylvania, and no member of the *C. acuminatus* complex has ever been recorded north of the Patapsco River basin in Maryland.



This crayfish, of the *Cambarus acuminatus* complex, was found in Valley Creek. Its identity has yet to be determined, but no member of this complex has ever been identified as far north as Pennsylvania.

Dr. John Cooper at the North Carolina State Museum is the expert who is currently describing and naming the various species in the complex. In 2004 he began studying the Valley Creek specimens collected in 2003. His work on the taxonomy will determine whether these samples belong to a species new to science or represent a range extension of a species reported farther south. It may be years until the *C. acuminatus* complex is sorted out and the Valley Creek crayfish is assigned a scientific name. In the meantime the park is home to a reproducing population of crayfish previously unknown in Pennsylvania. Furthermore, Valley Creek clearly supports a unique and potentially threatened crayfish population that is in need of further study and protection. ■

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Research learning centers contribute to understanding of coastal resources

By Lynne Murdock

THE NATIONAL PARK SERVICE develops research learning centers to facilitate research and provide educational opportunities throughout the National Park System. Each center is unique and focuses on resources particular to an area's geography, landscape, culture, and history. Hence, research learning centers are places where research, education, and community partnerships come together over shared natural, fiscal, and human resources. Several research learning centers that serve national parks along coasts made significant progress in research and education in 2004.

Ocean Alaska Science and Learning Center staff is using video to describe inventory and monitoring work. The finished product, available in 2005, will showcase three inventories: freshwater fish at Kenai Fjords National Park, small mammals at Katmai National Park, and vascular plants at Aniakchak National Monument. At Kenai Fjords, interpreters regularly present programs on the center's archaeological survey and research findings on the black oystercatcher (*Haematopus bachmani*), a bird species whose striking appearance (black plumage, large size, and bright orange bill) makes it quite unlike any other. Cooperating scientists at the science and learning center presented seminars in which they shared their research findings with the public. Staff also transfers scientific information to the public via regularly updated exhibits. For instance, at a facility operated by Fox Tours, a company owned by Alaska Natives, more than 30,000 people who participated in tours had the opportunity to see an exhibit that highlighted coastal archaeology, particularly research on the Aleutiiq culture.

The Urban Ecology Research and Learning Alliance and the National Capital Region hosted a science symposium, "Spotlight on National Park Resources," in March 2004. Investigators presented results from several ongoing research projects, including pollutants in the Chesapeake Bay watershed. Students and NPS staff attended the symposium, held at the University of the District of Columbia in Washington, D.C. Afterward, in order to inform other audiences, staff displayed posters from the symposium at the National Park Service offices at 12th and Eye Street.

In July 2002, Acadia National Park acquired a 100-acre (40-ha) property on the Schoodic Peninsula in Maine. This property, which will host the Schoodic Education and Research Center, houses a former naval base, including 36 buildings on 30 developed acres (12 ha); it is also home to pristine intertidal areas. Although park staff is already using the developed area for existing programs, it is investigating market demand and partnership possibilities for the future research learning center and considering research opportunities in the intertidal zones.

Education staffs from Channel Islands National Park and the Southern California Coast Research Learning Center, located in Santa Monica National Recreation Area, continue to benefit from

University of Alaska graduate student Julie Morse prepares to draw blood from a black oystercatcher with the assistance of NPS Resource Management Specialist Mike Tetreau. University involvement, fostered by the Ocean Alaska Science and Learning Center, has resulted in a high quality and quantity of data that would not otherwise have been gathered.

An archaeologist with the Smithsonian Institution shows a newly unearthed artifact to a park visitor in Kenai Fjords National Park, Alaska. This collaborative research project, sponsored by the Ocean Alaska Science and Learning Center, brings the National Park Service together with the Smithsonian, the University of California–Berkeley, the Pratt Museum, and the Alaska Native villages of Nanwalek and Port Graham.

academic and cultural connections made during the JASON Project, held at Channel Islands in January 2003. The yearlong program exposed 1.6 million students and 35,000 teachers to leading scientists who worked with them as they explored and examined planet Earth and its biological and geological development. Long-term relationships made with researchers at NASA, the National Oceanic and Atmospheric Administration, and the Santa Barbara Maritime Museum during the JASON Project have raised the quality of educational programs at Channel Islands National Park and increased the number of schools the Southern California Coast Research Learning Center reaches.

North Coast and Cascades Learning Network partnered with academic institutions such as the University of Washington to provide seed money in the form of grants for graduate students to do aquatic research in Olympic, Mount Rainier, and North Cascades National Parks. Additionally, investigators completed cultural research on the history of a large basket collection from Olympic National Park. Park interpreters will make this information, which had been stored in the park's natural history collection, readily available via the University of Washington Web site. ■

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Biodiversity explorations continue at Great Smoky Mountains ATBI

By Becky Nichols

The All Taxa Biodiversity Inventory (ATBI) aims to document all life in Great Smoky Mountains National Park (Tennessee and North Carolina), identifying not only the species but also their life histories, seasonality, distribution, and abundance. In 2004 the ATBI continued to make steady progress with new findings, fieldwork, and collecting events. Fifteen "mini-grants" were awarded for projects, including inventories of tardigrades (tiny animals called water bears), lichens, micromoths, ants, beetles, flies, worms, aphids, grasshoppers, and microfungi, to name a few.

Since the inception of the ATBI seven years ago, some taxonomic groups, such as the Lepidoptera (moths, butterflies, skippers), have a nearly complete checklist. Although the lepidopterists have selected slightly different summer dates for the three Lepidoptera blitzes to date, a reduced number of new discoveries has occurred with each subsequent blitz, as expected. About 300 species were added to the park's already active checklist during the first blitz, approximately 150 in the second blitz, and about 25 from summer 2004. The consensus is that many (but not all) species that fly in the summertime have been sampled adequately. Currently, more than 1,600 species of Lepidoptera are known from the park, and most of the researchers involved believe that the final number will be 2,000 to 2,500 or perhaps a little higher. Species that are difficult to find, such as those that live in unique habitats or that are highly seasonal, will add to this number. An autumn or late-winter/early-spring blitz is proposed for the next activity.

Documented as part of the Great Smokies ATBI are a spread-winged damselfly (family Lestidae, above) and an American climbing fern (*Lygodium palmatum*, below). Insects in this family are common inhabitants of small ponds, swamps, and stream pools. The fern has been found sporadically throughout the eastern United States but is considered rare in the national park.

In addition to collecting ecological, distributional, and other types of information about species, many scientists are collecting DNA material. In 2004 the lepidopterists concentrated on providing vouchered specimens for genetic analyses as part of the "Bar Code of Life" project at the University of Guelph in Ontario, Canada. Mycologists also are using genetic analysis, particularly for taxonomically difficult groups, some of which were collected at the national park as part of the Fungi Quest in the summer.

As of mid-December 2004, the number of new records for the park is 3,351. The number of species new to science has increased by more than 100 since November 2003, making the total now 539. ■

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Three new research learning centers open their doors in 2004

By Lynne Murdock

PEOPLE AND PARTNERSHIPS ARE THE HEART of research learning centers, but facilities—primarily existing park structures—and innovative funding arrangements keep it beating. In 2004, three new research learning centers opened their doors and began facilitating research and education in the National Park System in Alaska, Oregon, and Kentucky. In Denali National Park, a new building, with a dividable classroom, exhibit area, and office space for staff and visiting researchers, will house the Murie Science and Learning Center. Located next door is a new dining facility, which is shared with the park concessionaire, Doyon/ARAMARK Joint Ventures. In Crater Lake National Park, the former chief naturalist's and superintendent's houses, both on the National Register of Historic Places, will become the Crater Lake Science and Learning Center. In Mammoth Cave National Park, an existing park facility, known as the Maple Springs Research Complex, was remodeled to provide space for 43 visiting researchers and graduate students and classrooms to accommodate university and school groups.

Funding for the Murie Science and Learning Center in Alaska comes from a variety of sources: Doyon/ARAMARK Joint Ventures, the Denali Institute, and the Denali Borough School District. Crater Lake Trust, an offshoot of the National Park Foundation and a progressive friends group, manages an interest-bearing account with revenue from the sale of the Crater Lake "Centennial" license plate. This funding and a grant from Jeld-Wen enabled work crews to begin structural rehabilitation on the Crater Lake Science and Learning Center building. The Mammoth Cave International Center for Science and Learning entered into a cooperative agreement with Western Kentucky University to coadminister the research learning center's program. Under the agreement the university will provide a research director to manage scientific research projects that are associated with the center; the director will begin working in January 2005.

An important revenue stream for the Murie center is the park tour booklet, *Denali: A Living Tapestry*, published by the Alaska Natural History Association and marketed by Doyon/ARAMARK Joint Ventures to all visitors who take a tour in Denali National Park. Based on a percentage of profit from fee-based programs, the Denali Institute assists in operation of the center by providing additional funding for equipment and supplies. The Denali Borough School District is a

Department of the Interior (DOI) staff and friends celebrated the official dedication of the Murie Science and Learning Center on 16 August 2004. Visible left to right: Mike Sfraga (Denali Foundation), Jack Reiss (Doyon/ARAMARK Joint Ventures), Marcia Blaszak (Alaska Regional Director), Jan Murie (son of Adolph and Louise Murie), James Tate (DOI Science Advisor), Mark Moderow (Alaska Natural History Association), Randy Jones (NPS Deputy Director), Carol Lewis (University of Alaska–Fairbanks), and Paul Anderson (Denali National Park Superintendent). Not visible but also in the lineup were Bob Whicker (Denali Borough School District) and Marie Monroe (Doyon Limited).

Beginning with a carcass, middle-school students from the Denali Borough School District (Cantwell School) cleaned the bones and rearticulated this wolf skeleton, which now stands as the main display in the Murie Science and Learning Center.

donor and partner in the design and development of the Wireless Cloud Network, a state-of-the-art video teleconferencing and distance learning tool for park use. One strategic goal of the school district is to collaborate with the Murie center. As a frequent partner in grant writing, the district has made many of the center's programs possible. Through dedicated work with partners and the commitment of Denali National Park management, this research learning center is making great strides in serving a large geographic area with quality information and opportunities.

Ever since the discovery of Crater Lake—the deepest lake in North America at 1,932 feet (589 m)—scientists have been analyzing the lake's clarity and biological components. In addition to the decades of aquatic-based information that park staff and cooperators have collected, synthesized, and maintained, terrestrial studies are ongoing. Crater Lake National Park cultivates important working relationships with academic institutions such as Oregon Tech and Oregon State University; it also cultivates community appreciation. Not surprisingly, then, the National Park Service conceived the idea for a Crater Lake Science and Learning Center years ago, but in 2004 it was finally implemented.

The Mammoth Cave International Center for Science and Learning worked with the Karst Field Studies Program at Western Kentucky University to offer eight weeklong field studies to teachers, university students, and professional scientists. Research included monitoring of park salamander populations to determine species richness, abundance, and preferred habitats; a study to determine the impacts of introduced rainbow trout on the endangered Kentucky cave shrimp; quantification of ozone concentrations in Cumberland piedmont parks; mercury biomagnification in park biota; and long-term monitoring of cave fish, cave crayfish, and cave shrimp.

Through the use of innovative funding methods, existing park structures, and facilities integrated with park construction plans, these three research learning centers now serve parks, communities in which they reside, and other National Park System units in their regions. ■

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Electronic Authentication tested for Research Permit and Reporting System

By Derrick Dardano and Bill Commins

THE INTERNET PROVIDES AN EFFICIENT WAY to interact with the public, informing people about requirements and protocols and enabling them to participate in the permit application process. The Research Permit and Reporting System provides a Web site to communicate park research needs, park-specific permit conditions, and important contact information. The public uses the site to access this information and to apply for permission to conduct natural resource and social science research and collecting activities within U.S. national parks. Annual progress reports of permitted research are submitted to the National Park Service through the Investigator Annual Report process. The Research Permit and Reporting System also provides a Web site available only to National Park Service staff, which includes password-protected park research coordinator accounts used to track the processing of the applications into permit decisions. The system uses a standard set of procedures and products that respond to requirements of the Paperwork Reduction Act, including the use of auto-messaging to communicate with park research coordinators, curators, superintendents, and principal investigators.

The E-Authentication Initiative … is establishing a government-wide identity verification service for Web-based federal applications.

The current process for permit approval requires a paper component at the signature stage, with signatures required from the applicant, park approving official, and repository manager. Applicants must sign a copy of the permit, which is then countersigned by the park approving official. Specimen collection also invokes a signature routine between the park and repository manager.

NPSFACT

The National Park Service **issued 2,774 permits in 2004 for scientific research** and collecting activities conducted throughout the National Park System.* Since 2001, when such permits were first tracked, the numbers have continually risen, beginning with 2,231 that year, followed by 2,367 in 2002 and 2,501 in 2003.

**Permits are required for scientific research activities that involve natural resource or social science fieldwork and specimen collecting of biological, geological, or paleontological resources. Activities such as birding and noncommercial photography are not regulated by permit; some official research and collecting conducted by NPS staff requires a permit. Other permit procedures apply to scientific activities pertaining solely to cultural resources.*

As the National Park Service moves this process to an online environment, an important legal question must be addressed: Is an agreement binding if it is made online by parties whose identities have been electronically authenticated? To answer this question, the National Park Service sought the assistance of the E-Authentication Initiative.

The E-Authentication Executive Steering Committee awarded funding in 2004 to allow the National Park Service to test whether an electronic agreement using trusted credentials at an appropriate level of assurance matches the level of confidence it would have in an e-signature. Managed by the General Services Administration, the E-Authentication Initiative (an E-Gov project) is establishing a government-wide identity verification service for Web-based federal applications. A single, government-wide approach to electronic authentication allows the public to reuse identity proofing among different agency applications. The E-Authentication approach to identity proofing is based on four levels of assurance of the asserted identity of a person attempting to access online services. Agencies determine the level of risk associated with the transaction by performing a risk assessment, and then decide what level of assurance best mitigates the risk. The Research Permit and Reporting System can experience several levels of risk when working with each user. For example, the transaction of issuing a permit has a higher risk level than the submission of an application for a permit. The public acquires electronic credentials through a credential service provider. The electronic credential identifies the holder and his or her level of identity verification.

If the test proves the concept is workable, the National Park Service will consider adopting it for the Research Permit and Reporting System, making the process entirely electronic. The one-year project has a reporting extension of six months to allow for an entire research cycle (application, permitting, field season, Investigator Annual Report). The National Park Service provides project management, and Colorado State University supplies technical support and research under a cooperative agreement through the Cooperative Ecosystem Studies Unit of the Colorado Plateau. Field-testing will involve up to 20 volunteer parks, and Research Permit and Reporting System applicants who are willing to participate. Results of the testing will determine whether E-Authentication serves the needs of the parks and the scientific community. ■

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Fossil rhinoceros discovery at Wind Cave National Park

By Greg McDonald and Rod Horrocks

Fossils, like gold, are where you find them, but you can never be sure what type of fossils you will find—common or rare, fragmentary or complete. This is the challenge of not only the science of paleontology but also the management of fossil resources in national parks. What can start as a simple survey may result in an exciting discovery of scientific importance, which is exactly what happened at Wind Cave National Park in South Dakota.

In an effort to update the status of the park's fossil resources in 2003, resource managers inventoried some exposures where investigators had previously found fragmentary fossils. They fully expected that this survey would take only a single day and produce fossils similar to those previously found, for example ends of bones and teeth of a variety of animals. No fossils were found at the first few surveyed sites, but in the last area checked, investigators found both upper tooth rows of a skull. Examination of the immediate area revealed numerous remains of bones and teeth, which appeared to be from the skull and lower jaw of an extinct hornless rhinoceros called *Subhyracodon occidentalis.* Because of the fossils' fragile nature, park managers quickly made plans to conduct an excavation to properly document this find.

Totally unexpected, however, was the discovery of additional rhinoceros bones, indicating that the skull was not an isolated find but part of a disarticulated skeleton. Further excavation uncovered a partial skeleton of a small early horse, *Mesohippus*, and the remains of other animals such as an unidentified carnivore, a tortoise, and an early deerlike animal. Hence, what had started as a one-day excavation turned into two weeks of work during summers 2003 and 2004.

What makes this discovery so exciting is that in the Black Hills, fossils the same age as those of the well-known Badlands are rare, and the recovery of two partial skeletons even rarer. The study of both the animals and the sediments of the Centennial site, named in honor of its discovery during the park's centennial year, will provide important information about the environment of the Black Hills 34 million years ago. ■

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Physical science staff Rod Horrocks and Kali Pace apply plaster bandages to the articulated foot of a rhinoceros discovered at Wind Cave National Park.

Because the park does not have a fossil preparation lab, it developed a partnership with the nearby Mammoth Site in Hot Springs to enable volunteers, such as Niranjala Kottachchi (shown with the rhinoceros skull and jaw), to clean, repair, and catalog fossils for the park's museum collection and to prepare them for study.

award-winner

L. David Mech, leader in wolf research, receives Director's Award for Natural Resource Research

Dr. L. David Mech has studied wolves across North America, and his understanding of their behavior and ecological role has become the basis of wolf management throughout the Northern Hemisphere. He began his research 45 years ago in Isle Royale National Park (Michigan) as a graduate student observing wolves as they stalked, chased, and killed moose. Over the course of his career, he has continued to conduct research in the national parks and train students to do the same, especially in Isle Royale, Yellowstone National Park (Wyoming), and Denali National Park and Preserve (Alaska). These vast wilderness areas have been his laboratories. "National parks have long been critical locations for wolf studies," Dave says, "and I feel very privileged to have conducted most of my studies in them."

Perhaps his best-known contributions have come from his work at Yellowstone, where he played a significant role in the reintroduction of wolves at the park. At the beginning of the process, he was part of a group of 15 scientists who contributed to a report for Congress, *Wolves for Yellowstone?*, that laid the groundwork for the restoration. When the wolves were captured in Canada in 1995 and 1996, Dave helped oversee their capture, holding, processing, and transportation. After the wolves were brought back to Yellowstone and central Idaho, Dave testified as an expert witness on behalf of the government in a court challenge to wolf restoration. He started the Durward Allen Fund (named for his own mentor) with a large personal contribution to the Yellowstone Park Foundation to initiate an intensive wolf research program. He continues to lead research on wolf-prey interaction at Yellowstone, and his published findings have had a direct impact on current understanding and management of these predators.

Dave's work at Yellowstone is a small sample of his accomplishments. He pioneered the use of wildlife telemetry and, with graduate student Shannon Barber, produced a report for the National Park Service discussing and critiquing its use. The report has been very helpful to wildlife biologists in many park units. He founded the International Wolf Center in Ely, Minnesota, to support the survival of wolf populations by teaching about their role in the wilderness. He has published numerous articles and 10 books, including two comprehensive works on the wolf. Currently he is senior scientist at the USGS Biological Resources Division, Northern Prairie Wildlife Research Center, and works out of the Raptor Center at the University of Minnesota in St. Paul. Dave is a lifelong student of wolves and teacher about wolves for professionals and the public. As a result of his efforts, the human role in the wolf's future will be an enlightened one. ■

Documenting a 30-million-year-old landscape and its inhabitants at Badlands National Park

By Rachel C. Benton, Emmett Evanoff, Carrie Herbel, and Dennis O. Terry, Jr.

The Badlands of South Dakota are teeming with evidence of life from 30 million years ago. Slopes, pinnacles, and buttes are eroding and revealing a once-verdant grassland. In summer 2004, field paleontologists recorded new fossil localities in the Poleslide Member of the Brule Formation in Badlands National Park. They used GPS to record the information and entered the data into the park's GIS database. They also collected, prepared, and cataloged all scientifically significant fossils through the NPS Automated National Catalog System (ANCS+) curatorial database. The three-year project, funded through the Natural Resource Preservation Program, is a detailed study of the abundance and diversity of vertebrate fossils, their stratigraphic position, and their associated depositional environment. In addition, researchers from the park, museums, and universities are looking at the impact of visitor use on these fragile resources. By comparing areas of high visitor use with isolated locations, investigators can estimate the amount of fossil material lost to theft.

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The Poleslide Member provides the earliest evidence of the widespread prairie that now covers the Great Plains. Geologists have determined that the member is composed of homogeneous, windblown sediments (loess), punctuated by periods of landscape stability represented by ancient soils. Even after several years of intensive paleontological surveys, the Poleslide Member in the Cedar Pass area continues to yield rich fossil finds, except in heavily used areas. The Cedar Pass location is distinctive because it provides access to rocks and fossils from the Poleslide Member not readily available in other parts of the park; therefore, this study site reveals the relative abundance of fossils that are likely to be found in this rock unit as it is exposed throughout the park. The Poleslide Member around Cedar Pass provides a unique opportunity to inventory an ancient ecosystem, decipher fossil loss, and obtain a baseline of animal assemblages that existed 30 million years ago. ■

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The White River Group, which is composed of three rock formations, is exposed at Badlands National Park. The Poleslide Member of the Brule Formation has yielded many new fossil localities and valuable information about animal assemblages in a 30-million-year-old ecosystem.

Rocky Mountain National Park archives animal tissues for research on chronic wasting disease

By Terry Terrell

Unparalleled as laboratories for certain types of research, national parks also are invaluable as sources of research materials for scientists who may never set foot in a park. Rocky Mountain National Park (Colorado) has been working with NPS veterinarian Margaret Wild (see related article on page 19) to archive deer and elk tissues collected by park staff for purposes of chronic wasting disease (CWD) management. Chronic wasting disease is a fatal brain-wasting disease that affects ungulates across most of the United States and parts of Canada and is becoming more prevalent among wildlife in national parks. Most of the animals collected are known or highly suspected to have CWD and are being removed from the population to prevent disease transmission; a few were found dead, appearing to have died of the disease. The tissues are used by researchers interested in studying CWD and in developing animal-side tests (those that can be accomplished in the field—beside the animal) and vaccines for control of this disease. Most management actions undertaken by state game management agencies do not include testing animals slaughtered to control CWD or archiving tissues, and, though they may use tissue samples for their own research purposes, they are unable or unwilling to share samples. This has hampered the infant field of research on quick diagnoses and vaccine development that will ultimately provide vital tools for managing the disease.

Park staff administers antibiotics and fits a radio collars to a mule deer after performing a tonsillar biopsy. The collar will help staff find the deer in about two to four weeks if tests show the animal has chronic wasting disease.

Interest in this scarce resource is growing. Rocky Mountain National Park issued one permit in 2003 and three permits in 2004 for researchers to obtain samples from NPS archived tissues for further study. Under contract to the National Park Service, Colorado State University (CSU) performs the necropsies on the ungulates sent by the park. Tissues are archived in cold storage at CSU under the supervision of Dr. Wild. They are delivered to researchers after they obtain a research permit and sign a materials transfer agreement specifying that if any economically valuable benefits come from their research, they will sign a revenue-sharing agreement with the National Park Service. Although researchers are not sampling tissues in the park, they are accomplishing research vital to the park's future management of its deer and elk populations. The potential benefits of this research extend well beyond the boundaries of Rocky Mountain National Park to any land managers struggling to deal with the devastating effects of CWD. The park's contributions to this research may someday result in a way to control or cure this devastating disease. ■

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